

***Title: Roles of small ruminants in the rural livelihood improvement – Comparative analysis in Egypt***

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***Abstract***

The study focuses on the assessment of the contribution of sheep and goats to reduce poverty and vulnerability in rural farming systems of three agro-ecological zones in Egypt: the pastoral area of North West Coastal zone (Matruh), the irrigated areas in the Nile Valley (Sohag governorate) and the oasis area in the West Desert (New Valley governorate). An empirical study on 90 farms in the three agro-ecological zones on different social and economic indicators related to poverty gave indicators on the roles of sheep and goat in different farm types, according to resource endowment (land, livestock, capital, etc.) and human resources.

The results show different contributions of animal species to household livelihood according to asset endowments, societal and agro-ecological environments. For the landless and very small land owners, sheep and goat provide the main source of income to escape from poverty trap. The results show also some gaps between capital asset and poverty, especially for large herders in the pastoral and agro-pastoral zones of Matruh. The livestock asset generates other sources of wealth that are not taken into account in monetary poverty approach.

**1. Introduction**

Livestock had known a very large, but controversial, interest in the international community since the two last decades. The publication of Delgado et al. (1999) had underlining the future economic development of this sector in the South with the demographic and economic growth, mainly in intermediaries' countries. In the same time, this development raises controversial impacts on the environment; livestock being either accused to contribute 18% to greenhouse effects (Steinfeld et al., 2006 ; World Bank, 2009), or a way to valorise harsh environments (Faye et al, 2001). In pastoral and agro-pastoral areas, the overstocking during the drought years of the seventies and eighties is regularly invoked to explain range degradation in the dry lands of Africa.

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More recently, the international community recognizes the importance of livestock in terms of poverty reduction and economic opportunities. More than 150 millions of poor in Sub-Saharan Africa depend on livestock activities for their survival (Ashley et al, 1999); livestock is considered as the main asset for landless or very small scale farms (FAO, 2004). In Maghreb, more than 3 millions of family depend on small ruminants to ensure their survival in dry land areas (Alary et al., 2004).

Main recent studies highlight the different roles of livestock outputs in terms of food production, food security, income generation, employment all along the livestock chain, capital asset, but also in terms of services and inputs' supply to agricultural sector: manure, transport and draft animal, biological diversity, etc (Asley et al, 1999; Faye et al, 2001; Thornton, 2010). Livestock and specifically small ruminants contribute to the development of areas where others activities are not possible; they constitute a way to face risk events such as drought or family urgent needs (feast, health) or social events (birth, marriage, ...) (Faye et al. 1999). Many researchers gave evidences of the multiple roles of small ruminants in harsh Mediterranean environment (Haelein, 2001; Haenlein et al, 2004; McDowell and Woodward, 1982) and also as a pathway out of poverty (Peacock, 2005; de Vries, 2008; de Haan, 2000).

In the South Mediterranean, such as in Egypt, small ruminant and camel constitute the most valuable activities in arid areas thanks to their resistance to dry or hot conditions. This resistance to harsh conditions measured in terms on adaptive characters or rusticity, is based on different capacity: mobility, physiology, feeding pattern, etc. Furthermore, sheep and goat need low investment capital and fast rate of reproduction covers short term expenditures.

Despite its potential importance to sustainable economic growth and poverty reduction, livestock sector development has received limited attention from the international community and national governments in recent decades. In Egypt, agropastoral and pastoral areas got less social and policy interest, due to their marginal contribution to economic growth and food security. Irrigated system in the Nile delta and valley has allowed the development of large ruminants' husbandry based on forage production: *Trifolium alexandrinum* named Berseem and *Medicago sativa* named Alfafa. And SR population represent around 50% of the total ruminant population against more than 80% for the majority of the countries in Near East and North Africa region (FAOSTAT, 2009; Alary, 2010). However, Egypt registers the highest annual growth rate of small ruminants during the two last decades in North Africa region. More than three quarters of the SR population are based in Nile Delta and Nile Valley where farmers are vulnerable to the erratic climatic events. Sheep population showed the largest population increase from 3.1 million to 5.3 million over the decade 1995-2005, while goat population increased from 3 to 4 million and cattle population from 3 to more than 4.5 million in the same period. One third of sheep and goat population is in Upper Egypt, followed by West delta with 22.8% of the population and Middle Egypt for goat with 23.5% of the population. How to explain this increase of SR population in intensive agriculture conditions? This is one of objective of the present study.

Based on livelihood research approach (Ellis et al., 2003), the present paper proposes to analyze the contributions of small ruminants activities in terms of income generation, food security and capital endowment in three contrasted regions of Egypt: the pastoral systems of North West Coastal zone (Matruh), the intensive systems in the New Valley (Sohag governorate) and the oasian systems in west desert of Egypt (New Valley governorate).

## **2. Review on the roles of small ruminants in terms of poverty reduction and livelihood improvement in Egypt**

A rapid review of research studies in Egypt reveals the importance given to analysis of economic and biological efficiency of sheep or goat production systems. Almahdy and Metawi (2000) show that economic efficiency expressed as the yearly net income per ewe is significantly correlated to the ewe body weight and the age of marketing of lambs. El-Nagar et al. (1988) and El-Miniawy et al. (1992) have recorded some statistics on the contribution of different productive activities in the small ruminant farming systems to the household income in the North West Coastal zone. From the coastal to remote areas, the agricultural and livestock contribution increases from 25% to more than 70% in the total income. In very remote areas, the main source of income comes from extensive SR breeding on rangelands. Soliman (1990) estimated that the contribution of sheep and goats to the livestock income of Egyptian farmers is 9% for farms less than 5 Feddans (1 Feddan = 0.42 ha) but 2% for larger farmers.

Field surveys conducted on small mixed farms in newly reclaimed area in Egypt (Ahmed et al., 2006) showed that the gross margin of large ruminant activity is between 94 and 145 US\$ per animal compared to 85-102 US\$ per feddan for berseem (*Trifolium alexandrinum*) or groundnut which register the highest margins. Similar work in Sohag region recorded gross margins of about 12 to 22 US\$ per ewe and 4 to 12 US\$ per doe (Anonymous, 2009). The field data revealed causal relations between flock size of sheep and family size and between flock size of goat and berseem cultivation within the location. These results reveal different roles of sheep and goat; sheep and goat are considered both as a source of cash flow to cover family basic expenditures, but goat becomes more profitable in marginal or unfertile lands.

Ahmed et al. (2006) have developed a linear programming model to determine the optimum combination of crops and livestock production. They showed that there is no feasible solution to satisfy family basic needs from traditional farms with less than 4.6 feddan, which constitutes majority of the farms.

Siddik (2009) reported that poverty indices recorded significant decrease from 1995/96 to 2004/05 (from 22.9 to 19.6%) while rural poverty increased from 23.3 to 26.8% during the same period. The poverty percentage was the highest in Upper Egypt Rural areas (29.32%) and Lower Egypt rural areas (21.53%). There was a strong relationship between number of small ruminants per feddan and poverty level. This means that small land owners or landless invested in small ruminants to cover family needs. The livestock per capita income varied from 70-88 US\$ in Delta, Middle and Upper Egypt up to 155 US\$ in the border governorates. The main constraints of livestock development in Egypt were the lack of know how to use crop residues, the unavailability of credit lines for landless and small-scale landowners and the absence of livestock breeders associations.

This causal relation between SR and poverty may explain the negative perception of small ruminant from policy makers. SR is seen as a sign of poverty (unable to invest in large ruminants such as buffaloes or cattle). Yet it is difficult to find research studies that approach the roles of SR in the system. Gihad and El-Bedawry (2000) cited by Haenlein and Abdellatif (2004) determined that for the price of one buffalo, a farmer could buy 10 goats, which would produce 25% more cash income than the buffaloes. Goat is more profitable than sheep because they are more prolific and more tolerant to harsh environment. But this statement didn't include the financial and economic costs, in terms of family labour, knowing that cut

and carry and indoor feeding systems are more labour intensive per animal unit. Generally in this system, animals constitute a flexible source of cash, enabling farmers to purchase farm inputs and meet other urgent needs and also a buffer against non remunerative crops prices or poor harvest (Tabana *et al.*, 2000). It is also a source of animal protein and a way to satisfy the social events/ceremonies. However few studies describe the roles of small ruminants' activities in the household economy in terms of their contribution to reduce poverty and enhance livelihood improvement. The comparison between small ruminant and land gross margin cannot reflect the multipurpose functions of animals.

### 3. Materials and method

During the year 2010 three farm surveys were organized among a stratified sample of 90 farms in three agro-ecological areas: the rainfed arid area of Matrouh, the intensive agriculture areas of Sohag in Upper Egypt and the Oasis region in New Valley (map 1).



Map1: the three studied locations in Egypt

The three regions represent different integrative agriculture-livestock systems with different levels of intensification according to irrigation access and land fragmentation.

The rainfed production system is a complex system based on livestock, annual crops (mainly barley), tree, and off farm jobs. This system is well developed by traditional farmers (Bedouins) in North coastal zones. It is commonly distinguished in 4 main sub-systems according to the agro-ecosystems (Matrouh project, 2002): “(i) a narrow coastal strip, about 5 km inland, which has good alluvial soils and horticulture is the main farming activity, with

*livestock and barley; (ii) a mixed production strip, 5-15 km inland, of lower rainfall and soil quality, and a mixed small ruminants-barley FS prevails with orchards grown in the wadis; (iii) a rangeland strip, 15-50 km inland, of semi-nomadic population, largely used for area lies beyond 50-km inland, where a nomadic population are living on animal production, mainly camels". Generally family lives in transhumant conditions. The feeding system is based on barley and rangeland. Transhumance is practiced during late spring for grazing residuals crops and during winter in the common pastures (desert) when the pluviometry is good. Meat production is the main output; milk is used for domestic consumption. The main local milk product is a hard cheese called "Gamid" that can be refreshed with water and used as raw milk. According to Alsheikh et al (2006), the main constraints of these systems are the highly fluctuating feed supply due to the erratic rainfall which affects production and reproductive performances of animals: number of offspring per female and per year, body weight and milk yield.*

The irrigated production system is a typical mixed agriculture-livestock system that represents the majority of farms in the Delta and Nile Valley (around 76% of farming systems according to Tabana et al., 2000). The livestock activity integrates large ruminants (cattle and buffaloes), small ruminants and rural poultry. The feeding system of ruminants is based on berseem, green corn, crop residues and external feedstuff and concentrates.

In densely populated zones along the Nile Valley, the mixed system is close to the farmyard household system in which small ruminants are associated with other animals: poultry, cattle and buffaloes. Farm size is usually small (less than 5 feddans) with high cropping intensity. The flock size is small around 2-5 heads.

The common feature between the three areas is their high poverty status and social vulnerability. One hypothesis is that sheep and goat activities may be one way to face socioeconomic constraints such as poverty, land fragmentation and climatic changes.

Table 1: Description of the farm survey- April to June 2010

Governorate	Location	Sample
Matruh	- Matroh - Negila - Sidi Barani	30
Sohag	- Sohag city : 2 villages - Al Muncha : 2 villages - Saqolta : 2 villages	30
New Valley	- El Karga - Darlha - Paris	30

A stratified sample was utilised based on two hierarchical criteria: 1. the location of the villages (their distance and access to the main city), and 2. The flock size at the farm level. In the New valley region, with the agriculture land scarcity, landless farmers were also surveyed. The farm survey was based on a questionnaire with three components: 1. Farm and family history; 2. Farm description: cropping and pasture lands, livestock system, off farm activities, and farm facilities; and 3. Risk and poverty perception and the role of SR to manage family risks. The farm description on livestock system comprised different aspects such as herd structure, fattening practice, marketing strategy and domestic consumption, feeding system and other expenditure (labor, feedstuff and concentrates, veterinary costs).

To understand the socio-economic status of farmers and more precisely the roles of livestock in the reduction of vulnerability, we used the conceptual and methodological approaches developed in the livelihood approach. Within the general framework proposed by Carney (1999) in figure 2, we focused our approach on the evaluation of the livelihood assets that constitute a way to estimate the degree of vulnerability of the studied populations.

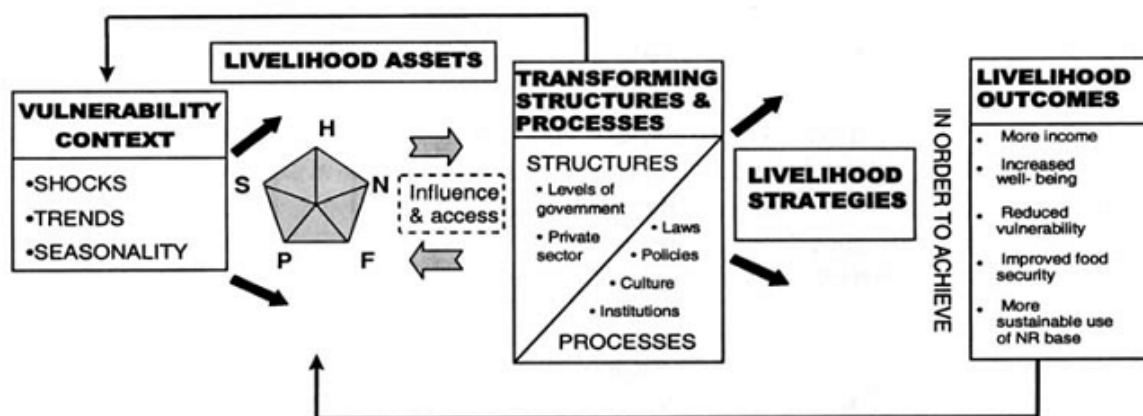


Figure 2 Schema of the livelihood approach (Source: Carney, 1999)

So the study focuses on the description of the farm and family livelihood assets in order to determine the relative contribution of livestock in poverty reduction. The analysis used also qualitative data on the social capital at the family and community level and the risks and poverty perception.

#### 4. Results

Each studied zone has specific agro-climatic conditions that determine the dominant crop and livestock activities and the differences between the geographical zones. Table 2 gives some characteristics of the farming system prevailed in each zone.

Table 2: Characterization of farming system in the 3 zones (average and standard deviation in brackets)

Zone	Farming system	Cropping system	Share of fodder crop on cultivated area (%)	Av. Small ruminant heads	Av. large ruminant heads	Feed cost per SR head in US\$
Sohag	Mixed crop-livestock farming system	Green maize: 36,8%; wheat:20,9%; berseem: 18,2%; fruit tree: 6%; sorghum: 5,8%:	66,5% [15%]*	7 [15,7]*	4 [4,8]*	105 [187]*
New Valley	Oasian system	Wheat:22,7%; alfafa: 23,5%;berseem:17,6 %; green maize: 16%;other crops: 7%; barley: 5,4%;	58,9% [16%]*	54 [87,1]*	28 [45,6]*	66 [124]*
Matruh	Agro-sylvo-pastoral system	Barley: 83,4%; fruit trees: 15,6%	75,26% [20%]*	122 [155,9]*	1 [3,9]*	459 [205]*

\*Standard deviation in brackets

The three systems are oriented to animal production with 60-75% of the land allocated to fodder crops, the largest small ruminant herds are found in the pastoral zone of Matruh governorate based on a barley-pastoral system. During dry years, farmers are obliged to purchase all feed requirement to maintain their stock. In 2010, a dry year following number of dry years, the average annual feed cost was around 80 US\$ per head of small ruminants.

In Sohag and New valley governorates the livestock system is mainly based on fodder crops such as berseem in winter and green corn in summer. According to the feed prices on the market in Sohag governorate, some farmers prefer to sell their forage, especially green corn, and purchase crop residues or clover hay for their animals. The variability of herd size is more important in the New Valley according to land tenure and water source depending mainly on the date of installation. Feed costs are the lowest in the New Valley due to their remoteness from the main markets of the Nile Valley.

To understand the link between small ruminant activity and the reduction of vulnerability, we used the capital asset approach. The two main hypotheses were: 1.The poverty level constitutes a first approach of the degree of vulnerability faced to external risks; 2.The capital asset radian allows analyzing the different role of small ruminant according to household capital asset composition. Four groups have been defined: 1. Very poor with less than 1.25 US\$ per capita; 2. Poor between 1.25 and 2US\$ per capita; 3. medium: 2 to 6 US\$ per capita and 4. Rich: more than 6 US\$ per capita. Table 2 shows the repartition of the sample for each region.

Table 3: Repartition of the regional sub sample between the different levels of poverty

	Very poor (less than 1.25 US\$/day)	Poor (between 1.25 and 2 US\$/day)	Medium (between 2 and 6 US\$/day)	Rich (more than 6 US\$/day)
Matruh	76,7%	23,3%	0,0%	0,0%
New valley	37,9%	13,8%	27,6%	20,7%
Sohag	34,5%	34,5%	31,0%	0,0%
<b>All sample</b>	<b>50,0%</b>	<b>23,9%</b>	<b>19,3%</b>	<b>6,8%</b>

Firstly we note the high percentage of very poor (with less than 1.25 US\$/day/capita) in Matruh compared to the two other regions. This high percentage results mainly from the effects of the drought conditions that affect the zone since the last decade. Most of the breeders limit the sale of animals to cover urgent needs such as the purchase of animal feeds or the family basic expenditures. Moreover the second main source of income is the fruit tree. This year the yields are very low or nil for all the farmers. This explains why very large farmers are fallen below the poverty line this year.

In the Sohag and New valley governorate, we can distinguish two profiles of distribution of poverty. In Sohag there is an equal repartition between the three classes, very poor, poor and medium. Due to land fragmentation, few farmers reach the rich level. In the New Valley, the majority of “very poor” group are landless. The “medium” and “rich” groups cumulate different activities including government jobs that have been developed within socio-political program of seventies and with the New Land Reclaimed Program. The “poor” group reflects the situation of typical farmers that need to manage their small land.

The capital asset radars give some indicators to understand the different roles of activities to escape poverty.

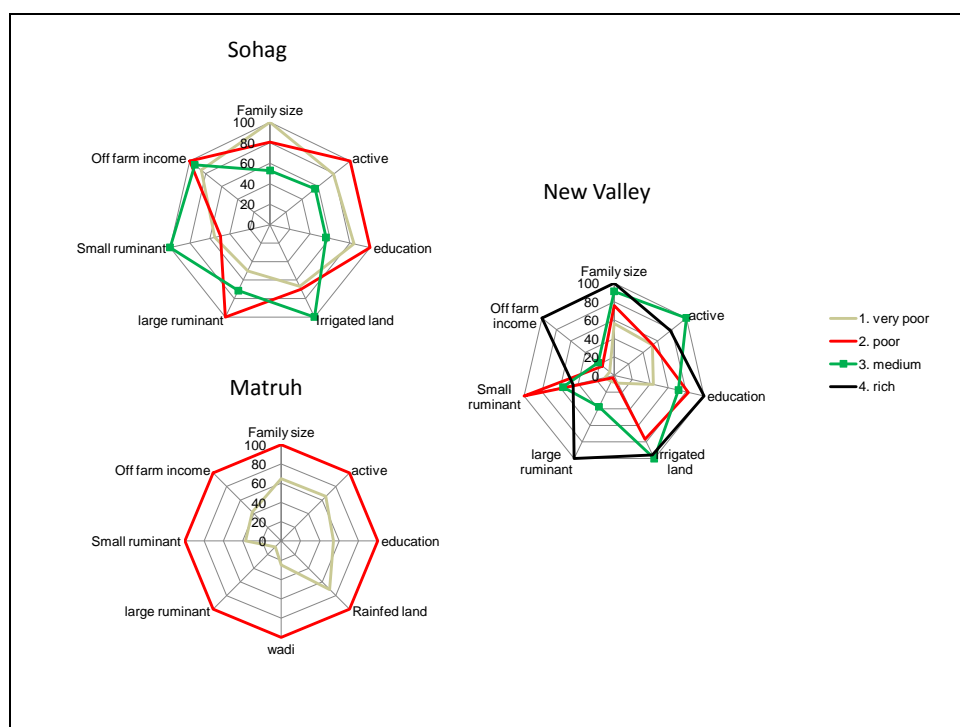


Figure 2: capital asset radar for the three regions (Egypt, 88 farmers)

Figure 2 shows very specific profile of capital asset according to each region and then to agro-climatic conditions. Matruh presents very specific profile due to the previously agro-climatic conditions during the last years. The SR flock size didn't allow escaping the poverty level fixed to more than 2 US\$/day/capita. However the poor group was proportionally better endowed in human, physical and financial capital than the very poor group. The main gaps between poor and very poor groups are the access to lowland area called *wadi* area, the animal stock and the off farm income. Among the "poor" group, 40% of the farmers have more than 100 heads of small ruminants compared to only 26% for the very poor. The farms with less than 30 heads in the poor group have around 8.5 family members compared to 13.3 for the very poor. So the family size, which may be a driving force during good climatic year, becomes a factor of poverty aggravation during dry years.

Sohag and New valley governorates present contrasted profiles in regards to the role of small ruminant. In the New valley governorate, the main asset for the poor group which can pass the poverty threshold of 1.25 US\$ per capita, is the sheep and goat stock. As soon as the households can invest in cattle, the household can escape the poverty trap. The main assets of the rich group in our sample are the large ruminant stock with a remunerative off farm activity thanks to a high degree of education. Therefore we can say that sheep and goat capitalization constitutes a first step to escape extreme poverty. Its part is decreasing again when the household can invest in large ruminants: cattle or buffaloes. Off farm activities constitute an important way to invest in large ruminant by providing a sort of collateral to bank' credits.



The education level is also a way to invest in land capital reserved for graduated on the new reclaimed lands.

Contrary to New valley, the main difference between very poor and poor groups in Sohag governorate is the large ruminants' asset. Only medium farmers invest consequently in small ruminants. SR is often a new activity for the farmers who are in a early phase of investment. The figure shows also that the "medium" group has a low level of education compared to the two poor groups. One hypothesis will be that SR activity may be one way to diversify economic activities without jeopardizing the farm economy in the case of low opportunity.

Now we propose to confront the monetary poverty status with the perception of the poverty in each area, mainly the main reasons and risks to become poor and the main factors to escape poverty (table 4 & 5).

Table 4: Main reasons to fall in poverty according to surveyed farmers (Survey: 90 farms, CIRAD/APRI, 2010)

Region	Drought	Land fragmentation	Social events	Employment	Livestock risk	Others
Matruh	91.7%	0%	0%	6.3%	0%	2.1%
Sohag	0%	54.9%	21.6%	9.8%	13.7%	0%
New Valley		56.7%	10.0%	16.7%	16.7%	0%

Table 5: Main factors to escape poverty according to surveyed farms (Survey: 90 farms, CIRAD/APRI, 2010)

region	Employment/ Off farm	Development project	Livestock development	Social nets	Others/ No answer
Matruh	38.0%	32.4%	18.3%	2.8%	8.5%
Sohag	64.4%	17.8%	8.2%	6.8%	2.7%
New Valley	26.6%	20%		16.7%	36.7%*

\* Majority of them invoke the reduction of the cost of life

The main reasons to be poor are coping with our analysis of poverty. The main reason in the rainfed area is the climatic conditions in Matruh governorate. In the irrigated areas, the main factors are land fragmentation in link with demographic and social pressure. The main risks mentioned in irrigated areas of animal rearing are animal diseases or the difficulties in developing animal activities. The main social costs declared by the farmers are the cost of the marriage, and the risks of health problems or the loss of the parents in an early age.

The main factors to escape poverty would be the off farm income diversification through migration and new job opportunities in rural areas. But we can observe different answers with the zones but also the past experience. All of them expected a lot from public support either on the way of development project or subsidies policy.

## 5. Discussions and conclusions

The field research work shows different contributions of animal species to household livelihood according to asset endowments but also due to social and agro-ecological environments. For the landless and very small land owners, sheep and goat provide the main

source of income to escape the poverty trap. As soon as the farmers are able to invest in large ruminants (cattle or buffaloes), sheep and goat become the basic cash flow while large ruminants provide a sort of family insurance. Poor farmers used mainly the common land along the canals or green berseem after large ruminants. Within some arrangements with large landowners, agricultural workers can have accessed to small part of land to graze.

In the New Valley and Matruh, one of the main constraints that affect sheep and goat keepers is the feed costs. In the New valley, the majority of herders maintain small flock as household (in enclosure). The feeding system is mainly based on green fodder (*berseem*) and wheat residues in winter and green corn in summer. In the New Valley, the problem of availability of water or the problem of water pump functioning led the farmers to buy feed stuff outside the New Valley and reduce the profitability of their livestock activity. This problem impedes also the development of milk productivity and mil marketing. In Matruh, the feed cost is completely linked to climatic conditions and the degree of remoteness. During the last years, herders were obliged to sell some animals to buy feed for their herds from the Delta. The straw was negotiated around 0.17-0.2 US\$/kg although some maize or cereal were bought around 0.21-0.24 US\$/kg. This dependence on feed from outside the region may be reinforced in the coming years due to different factors: the climatic change that can perturb the quantity and quality of ranges in rainfed area, water access in irrigated systems, feed prices in the market, etc. Some herders cover their feed costs by selling young animals, mainly males between 4 and 6 months old. Furthermore this fits with the development in market demand in nearby cities but could have important social and economic impacts at the territorial level.

In Sohag governorate, sheep and goat constitute one way of income diversification for the “medium” household who haven’t the resource to employ in other sectors. In the ‘poor’ categories, the farmer prefers to invest in large animals that constituted a more consequent social and economic capital, which is also the previously animal activity in the governorates.

If we cross poverty factors perception with the monetary poverty indications, some evident factors such as climatic factor in rainfed area and land fragmentation in irrigated areas are highlighted by the majority of farmers. In irrigated area, other factors mentioned are social events in Sohag, or the loss of job employment in New Valley. This corresponds to two particular realities. In Sohag, the main problem is land fragmentation because the married daughters leave the family with her land ownership. In the New Valley, the off farm job, mainly in the public services, has been developed during the seventies that allowed each family to have a secure source of income. The loss of this job due to the retirement or the death of the head of the family, creates uncertainty at the family level, especially for families which have no livestock. In this area, animal and off farm jobs are considered as source of income diversification.

The factors to escape poverty are more diversified and they are well embedded in the history of each area. For example, in Matruh, besides the off farm diversification, mainly through the social networks at the Libyan-Egyptian border, one way to escape the poverty would be governmental development projects such as the Natural Resource Matruh project (NRMP), that had prevailed during ten years in the region. The development projects had supported the development of many activities with subsidies to the breeders. In Sohag and New Valley, the development projects provide mainly credits. The social support reflect mainly the development of social network to get job, facilitate migration, receive social support (religious associations), access to loan, exchange of animals, etc. The livestock development is mainly cited as one way to escape poverty in the Matruh region where livestock represent

the main asset to face climatic conditions. The perception of livestock to escape the poverty is completely linked to the flock size.

It is clear that the national data don't allow to approach the role of sheep and goat at the farm and regional level in terms of poverty reduction, reduction of vulnerability, and local food security at short and long terms considering, notably in harsh environments. A deeper survey on risk perception and the role of livestock will allow better understanding the role of livestock as a way of adaptation faced to global changes such as climatic changes in rainfed area or demographic change in irrigated areas.

The analysis of poverty profile in rainfed areas raised several questions. In such zone, we need to distinguish the structural poverty from the annual poverty linked to climatic conditions. The annual monetary poverty is not always a good indicator of the family poverty due to the strong social network in the society. In Matruh, an important economic activity emerges from the social network in the society. This activity is based on exchange of animals, keeper activities, smuggling activities at the Lybian-Egyptian border that can be linked. This conducts to the need to diversify the indicators of poverty in link with capital asset composition that reflect different roles of livestock at the family level.

The key roles of small ruminant stocks in the different farming/household systems explain its increasing population at the regional and the national level. Any development or research activity on small ruminants to sustain this endogenous development will need to understand well the multiple reasons of this development in link with the nature of animals and the family needs.

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